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Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for Clinical and Research Applications: Recommendations of the International RDC/TMD Consortium Network* and Orofacial Pain Special Interest Group**

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Abstract

Aims: The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) Axis I diagnostic algorithms were demonstrated to be reliable but below target sensitivity of $\geq$ 0.70 and specificity of $\geq$ 0.95. Empirical data supported Axis I algorithm revisions that were valid. Axis II instruments were shown to be both reliable and valid. An international consensus workshop was convened to obtain recommendations and finalization of new Axis I diagnostic algorithms and new Axis II instruments.

Methods: A comprehensive search of published TMD diagnostic literature was followed by review and consensus via a formal structured process by a panel of experts for revision of the RDC/TMD. The panel's recommendations for revision of the diagnostic algorithms were assessed for validity using available data.

Results: The recommended Diagnostic Criteria for TMD (DC/TMD) Axis I protocol includes both a valid screener for pain diagnoses and valid criteria (sensitivity $\geq$ 0.80, specificity $\geq$ 0.95) for the most common pain-related TMDs and for one intra-articular disorder. Diagnostic criteria for other common intra-articular disorders lacked adequate validity for clinical diagnoses but can be used for screening purposes. The Axis II protocol retains selected RDC/TMD screening instruments augmented with new instruments to better assess the interactions between pain and psychosocial functioning. A comprehensive classification system is also presented.

Conclusion: The recommended evidence-based DC/TMD protocol is appropriate for use in both the clinical and research settings. Simple Axis I and II screening tests augmented by validated Axis I and Axis II instruments allow for identification of simple to complex TMD patients.

Keywords

Diagnostic validity, diagnostic criteria, temporomandibular disorders, sensitivity, specificity.

Introduction

Temporomandibular disorders (TMD) are a significant public health problem affecting approximately 5 to 12% of the population.[1] TMD is the second most common musculoskeletal condition (after chronic low back pain) resulting in pain and disability.[1] Pain-related TMD can impact the individual's daily activities, psychosocial functioning, and quality of life. Overall, the annual TMD management cost in the USA, not including imaging, has doubled in the last decade to $4 billion.[1]

Patients often seek consultation with dentists for their TMD, especially pain-related TMD. A dual Axis Diagnostic Criteria for TMD (DC/TMD) with simple, clear operational definitions for the history, examination and imaging procedures are needed to render Axis I physical diagnoses in both clinical and research settings. Axis II biobehavioral assessment of pain-related behavior and psychosocial functioning - an essential part of the diagnostic process - provides the minimal information whereby the patient's pain disorder, especially when chronic, warrants further multidisciplinary assessment. A valid DC/TMD will provide evidence-based criteria for the clinician to use when assessing patients and facilitate communication regarding consultations, referrals, and prognosis.[2]

The research community benefits from well-defined and clinically relevant characteristics associated with the phenotype. When clinicians and researchers use the same criteria, taxonomy and nomenclature, then clinical questions and experience can be more easily transferred into relevant research questions, and research findings are more accessible to clinicians to better diagnose and manage their patients.

The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) has been the most widely employed diagnostic protocol for TMD research since its

publication in 1992.[3] This classification system was based on the biopsychosocial model of pain,[4] and this system included an Axis I physical assessment, using reliable and well operationalized diagnostic criteria, and an Axis II assessment of psychosocial status and pain-related disability. The intent was to simultaneously provide a physical diagnosis and identify other relevant characteristics of the patient that could influence the expression and thus management of their TMD. Indeed, the longer the pain persists, the greater the potential for patients to develop or amplify pre-existing cognitive, psychosocial, and behavioral risk factors with enhanced pain sensitivity, greater likelihood of pain persistence, and reduced probability of success from standard treatments.

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The RDC/TMD was intended to be only a first step toward improved TMD classification, and the authors stated the need for future investigation of the accuracy of the Axis I diagnostic algorithms in terms of reliability and criterion validity – the latter involving use of credible reference standard diagnoses, and to further assess the clinical utility of the Axis II instruments. The RDC/TMD Axis I physical diagnoses have content validity based on the critical review by experts of the published diagnostic approaches in use at that time and were tested using population-based epidemiological data.[5] Subsequently, a multicenter study showed that, for the most common TMD, RDC/TMD diagnoses exhibited sufficient reliability for clinical use.[6] While the validity of individual RDC/TMD diagnoses has been extensively investigated, assessment of the criterion validity for the complete spectrum of RDC/TMD diagnoses had been absent until recently.[7]

For the Axis II instruments, good evidence for their reliability and validity for measuring psychosocial status and pain-related disability already existed when the classification system was published.[8-12] Subsequently, a variety of studies have demonstrated the significance and utility of the RDC/TMD biobehavioral measures in predicting outcomes of clinical trials, escalation from acute to chronic pain, and experimental laboratory measures.[13-19] Other studies have shown that the RDC/TMD biobehavioral measures are incomplete in terms of better prediction of disease course[20-22] The overall utility of the biobehavioral measures in routine clinical settings has, however, yet to be demonstrated, in part because most such studies have to date focused on Axis I concerns rather than biobehavioral concerns. [23]

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The aims of this paper are to present the new evidence-based Axis I and II DC/TMD, to be used in both clinical and research settings, as well as the processes related to their development.

Methods

The National Institute of Dental and Craniofacial Research (NIDCR), recognizing the need to rigorously assess the diagnostic accuracy of the dual axis RDC/TMD, funded the multi-site Validation Project in 2001 that resulted in a dataset of 705 participants who were classified, based on reference standard diagnoses, into 614 TMD cases and 91 controls.[24] A description of the demographics, clinical characteristics and methodology is available.[24-26] Reference standard diagnoses were established by consensus between 2 TMD and orofacial pain experts using a comprehensive history, physical examination, and imaging studies (panoramic radiograph, and bilateral

temporomandibular joint [TMJ] magnetic resonance imaging [MRI] and computed tomography [CT]). Acceptable validity was defined *a priori* as sensitivity ≥ 0.70 and specificity ≥ 0.95.[3] When the RDC/TMD Axis I TMD diagnoses were compared to these reference standard diagnoses, the findings supported the need for revision of these Axis I TMD diagnostic algorithms to improve their diagnostic accuracy.[7] The Validation Project subsequently developed and validated revised Axis I diagnostic algorithms for myofascial pain and arthralgia that have excellent diagnostic accuracy.[26] However, revised diagnostic algorithms alone, without recourse to TMJ imaging, were still inadequate for valid diagnoses of two of the three types of disc displacements (DD) and for degenerative joint disease (DJD). Axis II instruments were shown to be reliable and valid for screening for psychosocial distress and pain-related disability, but revision was warranted for both increased scope and improved clinical efficiency.[27,28]

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In July 2008, a symposium at the International Association for Dental Research (IADR), "*Validation Studies of the RDC/TMD: Progress Towards Version 2",* was sponsored by the International RDC/TMD Consortium Network in Toronto.[29] Presentation of the revised RDC/TMD Axis I diagnostic algorithms and Axis II findings by the Validation Project's key investigators was followed with critiques from researchers in the areas of radiology, neurology, pain psychology, and TMD and orofacial pain.[30-35] A mandate emerged from the symposium in support of holding a consensus workshop for the development of a DC/TMD.

In March 2009, the "*International Consensus Workshop: Convergence on an Orofacial Pain Taxonomy"* was organized by the International RDC/TMD Consortium Network (IADR) and the Orofacial Pain Special Interest Group (International Association

for the Study of Pain), in Miami in order to address the recommendations from both the Validation Project investigators[28] and from the 2008 Toronto symposium regarding development of the DC/TMD. The Validation Project's findings and recommendations, as well as comprehensive literature searches regarding diagnostic tests, served as the basis for the resulting consensus-based recommendations that are available in the executive summary. [36,37] The ad-hoc Taxonomy Committee was appointed by the workshop participants and charged with finalizing the workshop recommendations; these recommendations were then reviewed by the workshop participants for feedback and approval. The Validation Project's findings and recommendations were subsequently published.[7,24-28]

The Validation Project team used the available dataset from that project, as appropriate, to assess validity for the changes to the Axis I diagnostic algorithms as recommended by the 2009 Miami workshop. These analyses were then reviewed, edited, and approved by members of the Taxonomy Committee. For the Axis II portion of the DC/TMD, the implementation of the consensus report from the 2009 Miami workshop was further refined based on recommendations from a subsequent workshop[38] and recommendations from more recent publications that built upon Validation Project findings.[27]

In July 2010, the working draft of the DC/TMD was presented to the international clinical and research community for critique and comments at a symposium in Barcelona, Spain (IADR). Further refinement of select DC/TMD diagnoses occurred in 2011 at the *International RDC/TMD Consensus Workshop* (San Diego) at the IADR. From 2011-2012, the examiner specifications for the Axis I assessment protocol and the

Axis II instruments were field-tested. In 2012, the DC/TMD manuscript was then reviewed and finalized by the Miami 2009 workshop participants for publication. Detailed information regarding the development of the DC/TMD is available on the International RDC/TMD Consortium Network website.[39]

Concurrent with the above activities was the development of a new taxonomic classification structure. The Taxonomy Committee and selected members of the 2009 workshop used the taxonomic structures developed by the American Academy of Orofacial Pain (AAOP)[40] in order to develop the structure used in this manuscript. The members of the workshops held in 2011 at San Diego and at the *International Consensus Workshop: Expanded TMD Taxonomy for Further Classification Research* in June 2012 at Iguacu Falls, Brazil (IADR) further refined this more comprehensive taxonomic structure and related diagnostic criteria. The AAOP council subsequently endorsed this taxonomic structure in 2012.

Results

Overview. The following recommendations represent an evidence-based DC/TMD intended for immediate implementation in clinical and research settings. The diagnostic algorithms and estimates of sensitivity and specificity for the most common TMDs are presented in Tables 1 and 2. Common TMDs include myalgia, myofascial pain with referral, arthralgia, TMJ disc displacements with and without reduction, TMJ subluxation, and TMJ degenerative joint disease. Decision trees are available which map the history and clinical findings to these specific disorders except for TMJ subluxation.[41] Acceptable sensitivity and specificity for a definitive diagnosis are

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considered as sensitivity ≥ 70% and specificity ≥ 95%.[3] Diagnostic criteria with sensitivity or specificity lower than these target values were used when there was no available alternative. Table 3 provides an inclusive taxonomic classification structure for both common and uncommon TMD. The criteria for the less common types of TMD have not been assessed for criterion validity. The revision of the AAOP criteria[40] presented here has undergone considerable review and has been updated as a result of the joint effort by members of the International RDC/TMD Consortium Network and the Orofacial Pain Special Interest Group of the IASP. These revised criteria for the less common TMD will be available on the Consortium website. As with the original RDC/TMD Axis I criteria, their diagnostic validity must be rigorously assessed. The Axis II protocol has been expanded by adding instruments to evaluate pain behavior, psychological status, and psychosocial functioning. The inclusion of the biobehavioral domain has been well-accepted in the pain field overall, and the specific inclusion of Axis II has been recommended as a general model for assessing any pain patient. [42] Finally, a "stepped" assessment model is embedded in the DC/TMD components, allowing the protocol to support assessment ranging from screening to comprehensive expert evaluation.

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1. Workshop Recommendations for Axis I Pain-related TMD Diagnoses

A. The Axis I TMD Pain Screener [43] is a simple, reliable and valid self-report instrument used to assess for the presence of any pain-related TMD with sensitivity and specificity > 0.95.[44] A 3-item version is suitable for epidemiological studies, while the full 6-item version has reliability sufficient for screening individuals for pain-related TMD. The full screening instrument provides one

method to obtain the necessary history for rendering a specific diagnosis in conjunction with the DC/TMD pain-related diagnostic algorithms (see below).

B. The changes in the diagnostic algorithms for the pain diagnoses in the DC/TMD, as compared to the corresponding disorders in the RDC/TMD, are summarized in Table 4. In the DC/TMD, myalgia has replaced the term myofascial pain, as found in the RDC/TMD. Further detail regarding these changes can be found in the Examination Specifications.[45] The diagnostic algorithms in the DC/TMD for arthralgia and myalgia now include criteria for modification of pain by function, movement or parafunction; these criteria are also included in the TMD Pain Screener. The clinical exam includes provocation tests for TMJ arthralgia of pain with any jaw movement (i.e., opening, excursive, and protrusive) and TMJ palpation. For myalgia, the tests include pain with opening jaw movements and palpation of the temporalis and masseter muscles. Pain from these provocation tests must replicate the patient's pain complaint.

C. The sub-disorder of myofascial pain with limited opening, as described in the RDC/TMD, is eliminated.

D. Myofascial pain with referral is included as a new type of disorder. The palpation procedure for eliciting referred pain, as a necessary criterion for this disorder, requires sustained pressure for 5 seconds.

E. For the DC/TMD, muscle pain diagnoses are organized into 4 major subclasses (see Table 3). Myalgia is further subdivided into three mutually exclusive types of myalgia: local myalgia, myofascial pain, and myofascial pain with referral. Sufficient data from the Validation Project existed to estimate the criterion validity

for myalgia as a class (sensitivity and specificity of 0.90 and 1.00, respectively) and myofascial pain with referral as a type of myalgia (sensitivity and specificity of 0.85 and 0.98, respectively). For the other two types of myalgia, local myalgia and myofascial pain, the combined sensitivity and specificity are 0.84 and 0.95, respectively. The diagnostic criteria for myalgia and myofascial pain with referral are listed in Table 1. Diagnostic criteria for local myalgia and myofascial pain will be available on the Consortium website. Therefore, if a diagnosis of myalgia is desired, and no distinction between the types is needed, then the more general diagnostic procedures are sufficient (see Table 1).

2. Workshop Recommendations for Axis I TMJ Disc Displacement (DD) and Degenerative Joint Disease (DJD)

A. The clinical procedures for assessing DD with reduction, DD without reduction without limited opening, and DJD lead to clinical diagnoses based on procedures that exhibit low sensitivity but good to excellent specificity. Consequently, for treatment decision-making in selective cases, confirmation of a provisional clinical diagnosis requires imaging. In contrast, the clinical procedures for assessing DD without reduction with limited opening have acceptable sensitivity and specificity, and the clinical evaluation may be sufficient for the initial working diagnosis.

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B. The changes made to the diagnostic algorithms in the DC/TMD for DDs and DJD as compared to the RDC/TMD are summarized in Table 5. Further detail regarding these changes can be found in the Examination Specifications.[45] TMJ

noise by history is a criterion for the intra-articular disorders of DD with reduction and DJD. For DD with reduction, examiner detection of clicking, popping or snapping noises during the examination is required. For DJD, the detection of crepitus during the examination is required, either by the examiner or by the patient with examiner assistance regarding clarification of type of noise present (e.g., crunching, grinding or grating noises). Inclusion of the latter criterion improved the sensitivity for this diagnosis from 20% to 49%. For DJD, no distinction between fine versus coarse crepitus is made. Finally, for DD without reduction, an assisted opening measurement (including the amount of vertical incisal overlap) of <40 mm yields the subtype of "with limited opening" while the measurement ≥40 mm yields the subtype of "without limited opening", and joint noises, if present, do not affect the diagnosis as long as the required criteria are met.

C. DD with reduction with intermittent locking and TMJ dislocation are included as new types of disorder. The diagnostic algorithms for these disorders include specific criteria from the patient history including current intermittent locking with limited opening and jaw locking in the wide-open position for DD with reduction with intermittent locking and TMJ dislocation, respectively.

D. Nomenclature change**:** The terms osteoarthritis and osteoarthrosis are considered to denote subclasses of DJD.

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3. Workshop Recommendations for Axis I Headache Disorders

"Headache attributed to TMD" is included as a new disorder type to replace "Headache or facial pain attributed to temporomandibular joint (TMJ)" disorder as described in the International Classification of Headache Disorders II (ICHD II).[46] The diagnostic algorithm for Headache attributed to TMD has been previously published.[47]

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4. Workshop Recommendations for Axis II Evaluation.

It is well recognized that the patient's cognitive, emotional, and behavioral response to pain are quite independent of the source of their pain so the workgroup recommended the use of instruments currently used in other areas of medicine to assess the psychosocial functioning associated with any pain condition. In addition, the Jaw Functional Limitation Scale was selected to assess jaw function specific to TMD. The criteria used to select the additional Axis II instruments were reliability, validity, interpretability, patient and clinician acceptability, patient burden, and feasibility as well as availability of translated versions for different languages and cultures. All areas of biopsychosocial assessment with the recommended instruments are available from the Consortium [48,49] and are summarized in Table 6.

A. Axis II screeners. Three simple self-report screening instruments are included for detection of pain-relevant psychosocial and behavioral functioning. The Patient Health Questionnaire-4 (PHQ-4) is a short, reliable, and valid screening instrument for detecting "psychological distress" due to anxiety and/or depression in patients in any clinical setting.[50] A cutoff of $\geq$ 6, suggesting moderate psychological stress, should be interpreted as warranting observation, while a

cutoff of ≥ 9, suggesting severe psychological distress, should be interpreted as warranting either further assessment or referral.[50] The Graded Chronic Pain Scale (GCPS) is a short, reliable, and valid instrument that assesses pain intensity and pain-related disability.[9] The two GCPS subscales are Characteristic Pain Intensity (CPI) that reliably measures pain intensity with ≥ 50/100 considered "high intensity" and the pain-disability rating is based on number of days that pain interferes with activity and on interference with social, work, or usual daily activities. High pain and high interference, or moderate to severe disability (classified as Grades 3 or 4) should be interpreted as disability due to pain, warranting further investigation and suggests a possible complex patient where the individual is experiencing significant life impact from the TMD. The third instrument is a pain drawing of the head, jaw and body and it allows the patient to report the location of all pain complaints.[51,52] Widespread pain suggests the need for comprehensive assessment of the patient.

B. Additional assessment instruments. The reliable and valid Jaw Functional Limitation Scale (JFLS) has a short form that assesses global limitations across mastication, jaw mobility, and verbal and emotional expression.[53,54] The Oral Behaviors Checklist (OBC) assesses the frequency of oral parafunctional behaviors.[55,56]

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C. Comprehensive Axis II Instruments. The remaining instruments to be used when indicated by specialists or researchers in order to obtain a more comprehensive evaluation of psychosocial functioning are listed in Table 6 and follow the Initiative on Methods, Measurements and Pain Assessment in Clinic Trials

(IMMPACT) recommendations.[57] Those recommendations include assessment of pain intensity, physical functioning (both general and disease-specific), and emotional functioning. In addition to measuring pain intensity and disease-specific physical functioning (via GCPS and JFLS, respectively, as described above), the DC/TMD includes new measures for a more comprehensive assessment of emotional functioning using the PHQ-9[58] for depression (with cutoffs of 5, 10, 15, and 20 representing, respectively, mild, moderate, moderately severe, and severe levels of depression) and GAD-7[59] for anxiety (with cutoffs of 10 and 15 representing, respectively, moderate and severe levels of anxiety). Finally, like the RDC/TMD, the DC/TMD retains a measure for physical symptoms using the PHQ-15 [60] (with cutoffs of 5, 10, and 15 representing, respectively, low, medium, and high somatic symptom severity) due to the overwhelming importance of overall symptom reporting in individuals with TMD.[61] The SCL90-based measures in the RDC/TMD were replaced in the DC/TMD for several reasons: length, public-domain, and application to medical settings.

5. Data Collection Forms and Examination Specifications. A short, focused Patient History Questionnaire (PHQ)[62] was developed to assess pain intensity as well as history of jaw noise, jaw locking, and headache potentially to be attributed to TMD. The PHQ provides the necessary history for the Axis I diagnostic criteria. The DC/TMD operational specifications for the clinical tests, examination forms, PHQ,

and biobehavioral assessment instruments can be downloaded from the Consortium website[37] and used without copyright infringement.

Discussion

The DC/TMD is an evidence-based assessment protocol that can be immediately implemented in the clinical and research setting. Compared to the RDC/TMD, the DC/TMD is easier to use, includes valid Axis I and Axis II patient screeners, and provides valid Axis I diagnostic algorithms for the most common TMD as part of a comprehensive TMD taxonomic classification structure. Axis I core assessment instruments assess history of jaw noise and locking, and headache attributed to TMD; Axis II core assessment instruments assess pain intensity, general functioning, jaw functioning, psychosocial distress, and potential contributing factors of parafunctional behaviors and widespread pain. These changes in the core patient assessment instrument set, as compared to the RDC/TMD, continue to serve as a broad foundation for patient assessment and further research. The DC/TMD includes important additions, deletions and modifications to the original RDC/TMD that deserve comment. These changes are a result of research findings and expert contributions from professional TMD clinical and research groups guided by the principle to create a parsimonious DC/TMD based on the best available evidence. This manuscript cites the core assessment instruments that existed at the time of this publication and these instruments will be updated as indicated in the future with the most current versions available on the Consortium website.[37]

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Changes to the RDC/TMD History and Examination

The criterion for a patient report of pain modified, that is, made better or worse, by jaw function, movement or parafunction is now a requirement for all pain-related TMD diagnoses; this feature is shared with other musculoskeletal pains.[63,64] Questions regarding pain modification are integral to the history provided by the TMD Pain Screener or by the more comprehensive DC/TMD Patient History Questionnaire that contains all of the history questions required for the DC/TMD diagnostic algorithms. Pain modification is especially important in differential diagnosis in a broader clinical setting when co-morbid conditions may be present, especially other trigeminal system-mediated pain conditions.

The clinical provocation of "familiar pain" has proved useful in the assessment of other orthopedic and pain disorders.[65-71] The rationale is that the clinician needs to provoke the patient's pain complaint in order for a positive examination response to be clinically meaningful. A patient report of "familiar pain" is required with pain provoked by jaw movement and/or palpation to diagnose pain-related TMD including arthralgia, myalgia and myofascial pain with referral. "Familiar pain" is pain that is like or similar to the pain the patient has been experiencing. The intent is to replicate the patient's chief complaint of pain(s) in such a way that the patient describes that provoked pain in the same way – because it *is* the same type of pain. This criterion minimizes false positive findings from pain provoking tests in asymptomatic patients and incidental findings in symptomatic patients. Similarly, a report of "familiar headache" is required from the examination as part of the diagnostic algorithm for what is termed "Headache attributed to TMD". It must, however, be emphasized that the presence of "familiar pain" is not

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associated exclusively with the diagnoses of myalgia, myofascial pain with referral, or arthralgia, as other conditions may cause "familiar pain" during jaw movement or from palpation of jaw structures such as muscle or joint. For example, rheumatoid disease affecting the TMJ and infection can result in the report of "familiar pain" from movement and/or palpation of the associated structures. In order for the criterion of "familiar pain" to lead logically to the specified diagnosis, the signs must explain the symptoms; the symptom history, or additional assessment, must effectively rule out other competing diagnoses.[72]

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For myalgia and myofascial pain with referral diagnoses, palpation of only the temporalis and masseter muscles is required; mandatory palpation of the temporalis tendon, lateral pterygoid area, submandibular region, and posterior mandibular region has been eliminated because of poor reliability,[73-75] and not examining these areas does not significantly affect the validity of these diagnoses.[26] For example, the lateral pterygoid is commonly tender in non-cases, leading to false positives in the RDC/TMD.[73] It is also uncommon for these other sites to be painful to palpation when the masseter or temporalis muscles are not, but they may be used when clinically indicated. For the same reason, palpation of the posterior aspect of the TMJ through the external auditory meatus has also been eliminated but can also be used when clinically indicated.

TMJ noises can be difficult to detect, even with auscultation using a stethoscope, and can be sporadically present. For DJD, including patient report of crepitus during the examination with guidance from the clinician substantially improves its diagnostic accuracy.[26] Patient report of noises such as crunching, grinding or grating noises (i.e.,

crepitus) typically requires reviewing these noises with the patient and then carefully interpreting their responses. The distinction between coarse and fine crepitus was omitted as these sounds are not reliably distinguished and the distinction does not contribute to DJD's diagnostic validity.

Changes to the RDC/TMD Pain Diagnoses

The RDC/TMD diagnosis of myofascial pain with limited opening has not yet demonstrated unique clinical utility and was eliminated. The remaining RDC/TMD diagnosis of myofascial pain has been reorganized in the DC/TMD into two new validated disorders: myalgia (as a subclass of muscle pain disorders) and myofascial pain with referral (as a type of myalgia); see Table 3. Myofascial pain with referral is a distinct clinical disorder with central convergence accounting for the referral of pain to other anatomical sites.[76-78] Referred pain has clinical utility for, at a minimum, differential diagnosis regarding the identification of pain in other anatomical locations, including referred pain to the teeth, that is ultimately pain of muscular origin.

The term "Headache Attributed to TMD" is a new Axis I diagnostic classification.[79] Tension-type headache (TTH) and migraine have been associated with TMD.[18,80-87] In particular, TTH and TMD share many symptoms,[18,87,88] although this may not imply identical pathophysiology or underlying mechanisms.[85,88,89] A subgroup of headache patients experience increased headache following masticatory system provocation such as clenching of the teeth (i.e., parafunctional behaviors).[85,86,89,90] Longitudinal studies have found that the development of TMD was accompanied by an increase in headache and that the presence of TMD at baseline predicted the onset of headache.[91,92] Finally, treatment of the masticatory system has also been associated

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with a report of decreased headaches. These findings suggest that some headaches may be secondary to TMD.[93-95]

Frequency of TTH[96] and migraine correlate with functional disability and is a useful patient characterization,[97-99] and increased frequency of headaches in the temples is associated with increased symptoms of painful TMD.[99] Future research will explore whether sub-classification of headache attributed to TMD, arthralgia and myofascial pain in terms of frequency of pain occurrence can also improve the identification of patients with more complex pain problems. Consequently, frequency and duration of "jaw pain" is included in a longer version of the DC/TMD Patient History Questionnaire, available on the Consortium website.

Changes to the RDC/TMD TMJ Diagnoses

A diagnostic category of DD with reduction with intermittent limited opening (i.e., episodic self-limiting "closed lock") was included in the DC/TMD. This is a common, clinically significant mechanical joint disorder that can require treatment. Another newly included diagnostic category is the mechanical joint disorder TMJ dislocation characterized by "open lock" of the jaw and typically diagnosed based on patient history. If the patient is able to reduce this dislocation it is termed "subluxation," and if the dislocation requires an interventional reduction it is termed "luxation". Sufficient data were only available to assess the diagnostic validity of subluxation.[100]

The low sensitivity for the diagnostic algorithms for DD and DJD suggest these criteria be limited to providing provisional diagnoses. For example, for a diagnosis of DD with reduction, a positive history of noise and the presence clinically of clicking noises (as specified) effectively rules in the diagnosis due to the criteria's high specificity, while

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a negative finding can be associated with false negatives due to low sensitivity. That is, some DD with reduction will not have clinically detectable noise, have fewer clicks or different types of noise, and will not be diagnosed using the clinical criteria.[101] Based on available data, DD with reduction are highly prevalent and are probably without clinical consequence in the absence of pain occurring with the noise, or presence of functional limitations such as limited opening or interference in mastication. Nevertheless, imaging using MRI and CT is required for a definitive diagnosis of TMJ DD and DJD, respectively, and especially when the DC/TMD leads to a negative outcome in association with a clinical history that suggests a clinically important disc–condyle complex disorder. The single diagnostic exception is DD without reduction with limited opening (i.e., "closed lock"), which shows good diagnostic validity without imaging (i.e., sensitivity 80%; specificity 97%). However, the criteria for DD without reduction with limited opening have not been assessed with subjects with other causes of limited opening (e.g., adhesions, coronoid hyperplasia or muscle contracture). The need for a definitive DD diagnosis, and thus the indication to use imaging is based on whether the information gained will change the patient's treatment plan or prognosis. Reliable imaging criteria for these disorders are available.[102]

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Taxonomic Classification Structure and Classification of the less common TMDs

A comprehensive taxonomic system is presented in Table 3. The diagnostic criteria for the less common TMD were derived from the AAOP guidelines augmented with the best available definitions for those TMD as well as those TMD not identified by the AAOP guidelines. These criteria will be available on the Consortium website where they can be continually updated as new information emerges. The AAOP-based diagnostic criteria

were developed by clinicians and researchers based on their experience and the literature.[40] However, as these criteria have not been assessed for diagnostic accuracy, special caution should accompany clinical use. Treatment decisions based on these diagnoses should be undertaken with careful consideration of all risks and benefits associated with the resulting care plan.

Nomenclature

Since the terms osteoarthrosis and osteoarthritis have not been consistently used in medicine, these terms were subclassified under the broader term DJD. Use of DJD is also endorsed by the American Association of Oral and Maxillofacial Surgeons.[103] When pain co-occurs with DJD, the additional diagnosis of "arthralgia" can be used – as is the case with DD. A former diagnosis of osteoarthritis by the RDC/TMD is now dually coded as both degenerative joint disease and joint pain.

Changes to RDC/TMD Axis II

IMMPACT guidelines for clinical trials assessing pain recommend that patients be assessed for pain intensity and emotional functioning as well as general and "disease specific" physical functioning.[57] These four domains are assessed using the core Axis II instruments of GCPS (pain intensity subscale), PHQ-4 (emotional functioning), GCPS (general physical functioning using the interference subscale) and the JFLS (disease specific physical functioning). The primary Axis II domains from the RDC/TMD have been retained but are now measured more efficiently. Domains that bridge behavior with Axis I and are of direct utility for the clinician and researcher have been added. The biopsychosocial model of pain recognizes that pain is not purely a sensory process but that it is always accompanied by cognitive, emotional, and behavioral aspects that

influence how a patient reacts to and reports pain, and that, in turn, result in coping strategies that may be helpful or harmful in maintaining adequate functioning. If these coping strategies are harmful, they can contribute to the development of chronic pain. Indeed, a set of psychosocial factors such as anxiety, depressed mood, psychological distress, fear-avoidance beliefs, catastrophic thoughts, passive coping strategies, and social isolation have been recognized as risk factors for the development of chronic pain in musculoskeletal disorders.[104-106] Similar risk factors have also been identified for chronicity in individuals with TMD.[17,61,107,108]

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In addition, psychosocial factors are at least as important for the treatment outcome as are initial pain intensity and physical diagnoses.[109,110] The expansion of Axis II instruments for the DC/TMD serves to better evaluate the patient's psychosocial and behavioral status in order to identify the presence of these risk factors that must be addressed from the beginning of any treatment and thereby decrease the risk of the patient developing chronic pain.[105,111] Core risk factor assessment instruments include the OBC to identify maladaptive parafunctional behaviors and the pain drawing to readily identify presence of widespread pain or other regional pain conditions. Frequent maladaptive parafunctional behaviors appear to create repetitive trauma to the masticatory system, and when the patient cannot learn to control them, the presence of significant psychosocial distress should be considered as another co-morbid condition contributing to the persistence of the disorder. Widespread pain suggests potential systemic disorders including rheumatic diseases and/or central sensitization (e.g., fibromyalgia) suggesting the need for further medical assessment. It is therefore advisable that the core set of Axis II instruments be used routinely in all clinical

assessments. Their use in the clinical setting will facilitate the prevention of chronicity among individuals with recent onset TMD and will result in more efficient management of chronic TMD.

An in-depth evaluation of the patient's psychosocial status is important for all research studies comparing TMD treatment modalities. Otherwise, it is difficult to foresee how such research that does not take into account important risk factors can improve our understanding of TMD and provide us with the treatment of choice.[23] This is because Axis II psychosocial factors have better prognostic value then Axis I physical diagnoses.[17,108]

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Clinical Application of the DC/TMD

The comprehensive evaluation necessary to design a specific patient's care plan is beyond the scope of this paper; the reader is referred to a clinical assessment protocol[72], for example, within which the DC/TMD can be used. Before using the DC/TMD, other orofacial pathology, including odontogenic pathology, trigeminal autonomic dysfunction cephalalgias, other headache disorders, and neuropathic pain disorders needs to be ruled out. An "unusual" presentation such as swelling, warmth and redness, autonomic signs, or sensory or motor deficiencies warrants high suspicion, since these are not typical TMD signs. The DC/TMD is an effective and efficient adjunct to well-developed clinical reasoning skills, keeping in mind that the history must lead to a provisional diagnosis and the clinical examination, augmented when indicated by other assessment tools, is needed to confirm or refute this provisional diagnosis. The validity of the diagnostic criteria revolves around use of reliable clinical tests; several versions of the clinical procedures are available on the

Consortium website.[45] Finally, multiple diagnoses are permitted: one of the muscle pain diagnoses (myalgia or myofascial pain with referral), as well as diagnoses for each joint (a joint pain diagnosis, any one of four disc displacement diagnoses, a degenerative joint disorder diagnosis, and/or a subluxation diagnosis). In addition to the formal DC/TMD diagnoses for the common disorders, other diagnoses as listed in Table 3 may be required in order to fully capture all findings; for example, a lateral pterygoid spasm could co-exist with a myalgia of the other masticatory muscles, resulting in two muscle diagnoses.

The DC/TMD assessment protocol has both screening and confirmatory tests for the most common Axis I physical diagnoses and for Axis II contributing factors (see Table 7). The Axis I TMD Pain Screener is recommended for all patients in any clinical setting.[44] A positive screen is followed by further evaluation to arrive at the specific TMD pain-related diagnoses. The Axis II screening instruments consist of 11 questions from the PHQ-4 and GCPS as well as a pain drawing with minimal burden to the patient and clinician;[9,50] their use is recommended when triage indicates a pain disorder is present, and their use should be considered mandatory in case of persistent pain lasting 6 months or longer or in the presence of prior unsuccessful treatment(s). Overall, the Axis II screening instruments identify barriers to treatment response, contributors to chronicity, and targets for further intervention.[14,15] Positive findings with these screening instruments require further investigation using either the comprehensive Axis II assessment instruments listed in Table 6, or referral to the patient's physician or a qualified mental health provider, ideally a health psychologist and/or psychiatrist depending on the findings from this assessment.[112]

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The final two Axis II instruments can be used with any patient. The OBC assesses for the presence of parafunctional behaviors which may be a form of trauma to the masticatory system.[113] Likewise, the JFLS can be used to identify jaw related functional limitations that may be present in any patient and then can be used to document changes over time. Axis II instruments and their application are discussed more fully elsewhere.[27,28,114] All Axis II instruments are available on the Consortium website.

Adjunctive Tests

The DC/TMD provides the core provocation tests necessary for the diagnosis of masticatory muscle and TMJ pain but false positives and negatives can occur. Adjunctive tests may include static and dynamic tests, joint play tests such as compression and distraction, bite tests, "end-feel" tests, clenching tests, and palpation of the other masticatory muscles that are not part of the core criteria[115-121] Even though these tests did not improve overall validity of the diagnostic algorithms, they may, nevertheless, be useful in specific circumstances where the history suggests a pain-related TMD and the formal DC/TMD examination protocol is negative.[26,119,121,122] When used, these adjunctive tests must also provoke "familiar pain". Occlusal tests also did not contribute to the diagnostic validity of any of the TMDs, but occlusal factors including intercuspal occlusal contacts, open bite, and the slide from centric relation to maximum intercuspal position can all be affected by DD and DJD[123] and documentation of occlusal status during initial assessment is warranted. The history and clinical examination remains the cornerstone for TMD diagnosis, and all adjunctive tests, including electronic diagnostic instruments, require assessment for their diagnostic

accuracy and evidence of incremental validity for a true positive diagnosis of TMD prior to being recommended for clinical use.[124-126]

Patient advocacy

The workshop had the benefit of obtaining patient advocate input. A paradigm shift was advocated from a doctor-based assessment to patient-reported assessment. In short, patients want their symptom experience to be a more central part of the assessment and treatment recommendations. For example, limited mouth opening has been traditionally assessed using less than 40 mm as a "cut-off" and recent population based study involving more than 20,000 individuals supports this cutoff.[127] An alternative perspective is to ask the patient if they perceive a limitation in their opening independent of this "cut-off". Ultimately, what the patient believes, feels and reports is as important as what the clinician is able to observe and measure.

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Future Directions

The DC/TMD, like the RDC/TMD, needs to be further tested and periodically reassessed to make appropriate modifications to maximize its full value as new research findings are reported. Ongoing changes and updates to the DC/TMD will be managed and available through the International RDC/TMD Consortium Network. We encourage the larger TMD community to make recommendations for its development including developing assessment tools for use in children and adolescents, validate the DC/TMD in diverse settings, and expand the Axis II tools in order to contribute to the ongoing development of its validity - and clinical utility.

In terms of immediate goals, ongoing processes through the Consortium include further development of the taxonomy for Axis I conditions and critical review of Axis II

constructs and instruments. Research regarding the ontological structure of both Axis I and Axis II concepts is ongoing in order to develop more logical taxonomic concepts. Axis III is being developed for identifying clinically relevant biomarkers such as quantitative sensory measures as well as genomic or molecular profiles. Finally, an Axis IV is envisioned as a method to classify a patient into clinically meaningful categories by collapsing large amounts of variability across biopsychosocial and molecular genomic domains through, for example, the use of modern clustering models.[128]

Although the DC/TMD will be in important tool for future research projects addressing the underlying TMD mechanisms and etiologies, the DC/TMD has limitations. It is now recognized that TMD is a heterogenous group with manifestations well beyond the signs and symptoms associated with the current Axis I diagnoses. TMD is frequently associated with complaints indicating one or more other persistent pain conditions.[10,129] This fact requires a broader assessment of TMD patients beyond Axis I, and it underlies the significance of Axis II and the current development of Axis III. A more comprehensive medical assessment of co-morbid physical disorders and biobehavioral status with expansion of Axis II risk determinants for TMD will allow for identifying subpopulations of patients based on underlying pathophysiological mechanisms.[130] This will lead to development of new algorithms and new diagnostic categories that are based on etiologies and a parallel classification based on mechanisms. Consequently, we expect that such categories, including the associated diagnostic procedures, will contribute to the development of personalized treatments for TMD patients - and other related conditions with a high comorbidity with TMD. We are

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at the beginning of a new horizon that shows great promise in producing new diagnostic procedures and treatment modalities for TMD and other inter-related conditions.

Conclusions

The DC/TMD is intended for use within any clinical setting and supports the full range of diagnostic activities from screening to definitive evaluation and diagnosis. The DC/TMD provides a common language for all clinicians while providing the researcher with the methods for valid phenotyping of their subjects – especially for pain-related TMD. Although the validity data identifies the need for imaging in order to obtain a definitive TMJ-related diagnosis, imaging should not be used routinely but rather considered when it is important to a specific patient or a research question. The Axis II screeners provide the clinician with an easy method to screen for pain intensity, psychosocial distress and pain-related disability in order to plan treatment and consider prognosis. The additional Axis II instruments, a core part of all TMD assessments, provide the clinician and researcher with current methods to further assess the status of the individual regarding multiple risk factors relevant to pain management. The DC/TMD is a necessary step towards the ultimate goal of developing a mechanism- and etiology-based DC/TMD that will more accurately direct the clinician in providing personalized care for their patients.

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Table 1. Diagnostic Criteria for the Most Common Pain-Related Temporomandibular Disorders

Myalgia (ICD-9 729.1)

Description		Pain of muscle origin that is affected by jaw movement, function, or parafunction, and replication of this pain occurs with provocation testing of the masticatory muscles.
Criteria	HISTORY	1. Pain[1] in the jaw, temple, in the ear, or in front of ear; AND 2. Pain **modified** with jaw movement, function or parafunction.
	AND	
	EXAM	1. Confirmation[2] of pain location in the area of the temporalis or masseter muscle(s); AND 2. Report of **familiar pain**[3] in the temporalis or masseter with <u>at least</u> 1 of the following provocation tests: a. Palpation of the temporalis or masseter muscle(s); OR b. Maximum unassisted or assisted opening.
Validity		Sensitivity 0.90; Specificity 1.00
Comments		The pain is not better accounted for by another pain diagnosis. Other masticatory muscles may be examined as dictated by clinical circumstances but the sensitivity and specificity for this diagnosis based on these findings has not been established.

Myofascial Pain with Referral (ICD-9 729.1)

Description		Pain of muscle origin as described for myalgia, with referral of pain beyond the boundary of the masticatory muscle(s) being examined when using the myofascial examination protocol. Myofascial pain with referral is a subtype of myalgia.
Criteria	HISTORY	1. Pain[1] in the jaw, temple, in the ear, or in front of ear; AND 2. Pain **modified** with jaw movement, function or parafunction.
	AND	
	EXAM	1. Confirmation[2] of pain location in the area of the temporalis or masseter muscle(s); AND 2. Report of **familiar pain**[3] with palpation of the temporalis or masseter muscle(s); AND 3. Report of pain at a site beyond the boundary of the muscle(s) being palpated.
Validity		Sensitivity 0.85; Specificity 0.98
Comments		The pain is not better accounted for by another pain diagnosis. Other masticatory muscles may be examined as dictated by clinical circumstances but the sensitivity and specificity for this diagnosis based on these findings has not been established.

Arthralgia (ICD-9 524.62)		
Description		Pain of joint origin that is affected by jaw movement, function, or parafunction, and replication of this pain occurs with provocation testing of the TMJ.
Criteria	HISTORY	1. Pain[1] in the jaw, temple, in the ear, or in front of ear; AND 2. Pain **modified** with jaw movement, function or parafunction.
	AND	
	EXAM	1. Confirmation[2] of pain location in the area of the TMJ(s); AND 2. Report of **familiar pain**[3] in the TMJ with <u>at least</u> 1 of the following provocation tests: a. Palpation of the lateral pole or around the lateral pole; OR b. Maximum unassisted or assisted opening, right or left lateral movements, or protrusive movements
Validity		Sensitivity 0.91; Specificity 0.96
Comments		The pain is not better accounted for by another pain diagnosis.
Headache attributed to TMD (ICD-9 339.0)		
Description		Headache in the temple area secondary to pain-related TMD[*] that is affected by jaw movement, function, or parafunction, and replication of this headache occurs with provocation testing of the masticatory system.
Criteria	HISTORY	1. Headache[1] of any type in the temple, AND 2. Headache **modified** with jaw movement, function or parafunction.
	AND	
	EXAM	1. Confirmation[2] of headache location in the area of the temporalis muscle(s); AND 2. Report of **familiar headache**[3] in the temple area with <u>at least</u> 1 of the following provocation tests: a. Palpation of the temporalis muscle(s), OR b. Maximum unassisted or assisted opening, right or left lateral movements, or protrusive movements
Validity		Sensitivity 0.89; Specificity 0.87
Comments		The headache is not better accounted for by another headache diagnosis.
Footnote		[*] A diagnosis of painful TMD (myalgia, myofascial pain with referral, or TMJ arthralgia) is derived using valid diagnostic criteria.

[1] The time frame for assessing pain including headache is in "the last 30 days" since the stated sensitivity and specificity of these criteria were established using this time frame. Although the specific time frame can be dependent on the context in which the pain complaint is being assessed, the validity of this diagnosis based on different time frames has not been established.

[2] The examiner must identify with the patient all anatomical locations that they have experienced pain in the last 30 days. For a given diagnosis, the location of pain induced by the specified provocation tests must be in an anatomical structure consistent with that diagnosis.

[3] "Familiar pain" (or headache) is based on patient report that the pain induced by the specified provocation test(s) has replicated the pain that the patient has experienced in the time frame of interest, which is usually the last 30 days. "Familiar pain" is pain that is similar or like the patient's pain complaint.

Table 2. Diagnostic Criteria for the Most Common Intra-articular Temporomandibular Disorders

Disc Displacement with Reduction (ICD-9 524.63)

Description		An intra-capsular biomechanical disorder involving the condyle-disc complex. In the closed mouth position the disc is in an anterior position relative to the condylar head and the disc reduces upon opening of the mouth. Medial and lateral displacement of the disc may also be present. Clicking, popping or snapping noises may occur with disc reduction.
Criteria	HISTORY	In the last 30 days,[1] any TMJ noise(s) present with jaw movement**.**
	AND	
	EXAM	1. Clicking, popping and/or snapping noise detected during both opening and closing, with palpation during at least 1 of 3 repetitions of jaw opening and closing, **OR** 2. Clicking, popping and/or snapping noise detected with palpation during at least 1 of 3 repetitions of opening or closing**;** AND 3. Clicking, popping and/or snapping noise detected with palpation during at least 1 of 3 repetitions of right or left lateral movements, or protrusive movements.
Validity		Without imaging: sensitivity 0.33; specificity 0.94. Imaging is the reference standard for this diagnosis.
Imaging		When this diagnosis needs to be confirmed, then TMJ MRI criteria[2] are positive for <u>both</u> of the following: 1. In the maximum intercuspal position, the posterior band of the disc is located anterior to the 11:30 position <u>and</u> the intermediate zone of the disc is anterior to the condylar head; **AND** 2. On full opening, the intermediate zone of the disc is located between the condylar head and the articular eminence.

Disc Displacement with Reduction with Intermittent Locking (ICD-9 524.63)

Description		An intra-capsular biomechanical disorder involving the condyle-disc complex. In the closed mouth position the disc is in an anterior position relative to the condylar head, and the disc intermittently reduces with opening of the mouth. When the disc does not reduce with opening of the mouth, intermittent limited mandibular opening occurs. When limited opening occurs, a maneuver may be needed to unlock the TMJ. Medial and lateral displacement of the disc may also be present. Clicking, popping or snapping noises may occur with disc reduction**.**
Criteria	HISTORY	1. In the last 30 days,[1] any TMJ noise(s) present with jaw movement; AND 2. In the last 30 days,[1] jaw locks with limited mouth opening, even for a moment, and then unlocks.
	AND	
	EXAM	Same as specified for Disc Displacement with Reduction. Although not required, when this disorder is present clinically, examination is positive for inability to open to a normal amount, even momentarily, without the clinician or patient performing a specific manipulative maneuver.
Validity		Without imaging: sensitivity 0.46; specificity 0.97. Imaging is the reference standard for this diagnosis.
Imaging		When this diagnosis needs to be confirmed, then the imaging criteria[2] are the same as for disc displacement with reduction if intermittent locking is not present at the time of imaging. If locking occurs during imaging, then an imaging-based diagnosis of disc displacement without reduction will be rendered and clinical confirmation of reversion to intermittent locking is needed.

Disc Displacement without Reduction with Limited Opening (ICD-9 524.63)		
Description		An intra-capsular biomechanical disorder involving the condyle-disc complex. In the closed mouth position the disc is in an anterior position relative to the condylar head, and the disc does not reduce with opening of the mouth. Medial and lateral displacement of the disc may also be present. This disorder is associated with persistent limited mandibular opening that does not resolve with the clinician or patient performing a specific manipulative maneuver. This is also referred to as "closed lock".
Criteria	HISTORY	1. Jaw lock or catch so that the mouth would not open all the way; AND 2. Limitation in jaw opening severe enough to limit jaw opening and interfere with ability to eat.
	AND	
	EXAM	Maximum assisted opening (passive stretch) < 40mm including vertical incisal overlap.
Validity		Without imaging: sensitivity 0.80; specificity 0.97. Imaging is the reference standard for this diagnosis.
Imaging		When this diagnosis needs to be confirmed, then TMJ MRI criteria[2] are positive for <u>both</u> of the following: 1. In the maximum intercuspal position, the posterior band of the disc is located anterior to the 11:30 position <u>and</u> the intermediate zone of the disc is anterior to the condylar head, **AND** 2. On full opening, the intermediate zone of the disc is located anterior to the condylar head. Note: Maximum assisted opening of < 40mm is determined clinically.
Footnote		Presence of TMJ noise (e.g., click with full opening) does not exclude this diagnosis.

Disc Displacement without Reduction without Limited Opening (ICD-9 524.63)		
Description		An intra-capsular biomechanical disorder involving the condyle-disc complex. In the closed mouth position the disc is in an anterior relative the condylar head and the disc does not reduce with opening of the mouth. Medial and lateral displacement of the disc may also be present. This disorder is NOT associated with limited mandibular opening.
Criteria	HISTORY	Same as specified for Disc Displacement without Reduction with Limited Opening.
	AND	
	EXAM	Maximum assisted opening (passive stretch) <u>≥</u> 40mm including vertical incisal overlap.
Validity		Without imaging: sensitivity 0.54; specificity 0.79. Imaging is the reference standard for this diagnosis.
Imaging		When this diagnosis needs to be confirmed, then TMJ MRI criteria[2] are the same as for disc displacement without reduction with limited opening. Note: Maximum assisted opening of ≥ 40mm is determined clinically.
Footnote		Presence of TMJ noise (e.g., click with full opening) does not exclude this diagnosis.

Degenerative Joint Disease (ICD-9 715.18)		
Description		A degenerative disorder involving the joint characterized by deterioration of articular tissue with concomitant osseous changes in the condyle and/or articular eminence.
Criteria	HISTORY	In the last 30 days,[1] any TMJ noise(s) present.
	AND	
	EXAM	At least one of the following must be present: 1. Crepitus detected with palpation during opening, closing, lateral, or protrusive movements**;** OR 2. Patient report of crepitus (e.g., crunching, grinding or grating noises) during the exam.
Validity		Without imaging: sensitivity 0.49; specificity 0.86. Imaging is the reference standard for this diagnosis.
Imaging		When this disorder is present, then TMJ CT criteria[2] are positive for at least one of the following: Subchondral cyst(s), erosion(s), generalized sclerosis or osteophyte(s). Note: Flattening and/or cortical sclerosis are considered indeterminant findings for DJD and may represent normal variation, aging, remodeling or a precursor to frank DJD.
Subluxation (ICD-9 830.0)		
Description		A hypermobility disorder involving the disc-condyle complex and the articular eminence: In the open mouth position, the disc-condyle complex is positioned anterior to the articular eminence and is unable to return to a normal closed mouth position without a specific manipulative maneuver. The duration of dislocation may be momentary or prolonged. When prolonged the patient may need the assistance of the clinician to reduce the dislocation and normalize jaw movement. This is also referred to as "open lock".
12	HISTORY	1. In last 30 days,[1] jaw locking or catching in a wide open mouth position, even for a moment, so could not close from the wide open position, AND 2. Inability to close the mouth without a specific manipulative maneuver
	AND	Although no exam findings are required, when this disorder is present clinically, examination is positive for inability to return to a normal closed mouth position without the clinician or patient performing a specific manipulative maneuver.
	EXAM	
Validity		Without imaging and based only on history: sensitivity 0.98; specificity 1.00.
Imaging		When this disorder is present, then imaging criteria are positive for the condyle positioned beyond the height of the articular eminence.

[1] The time frame for assessing these biomechanical intra-articular disorders is in "the last 30 days" since the stated sensitivity and specificity of these criteria was established using this time frame. Although the specific time frame can be dependent on the context in which the pain complaint is being assessed, the validity of this diagnosis based on different time frames has not been established.

[2] Ahmad M, Hollender L, John M, Anderson Q, Kartha K, Ohrbach R, Truelove, E and Schiffman E. Research Diagnostic Criteria for Temporomandibular Disorders: Development of Image Analysis Criteria and Examiner Reliability for Image Analysis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009;107:844-860.

Table 3. Taxonomic Classification for Temporomandibular Disorders

I. <u>TEMPOROMANDIBULAR JOINT DISORDERS</u>

- **1. Joint pain**
  - A. Arthralgia
  - B. Arthritis
- **2. Joint disorders**
  - A. Disc-condyle complex disorders
    - 1. Disc displacement with reduction
    - 2. Disc displacement with reduction with intermittent locking
    - 3. Disc displacement without reduction with limited opening
    - 4. Disc displacement without reduction without limited opening
  - B. Hypomobility disorders
    - 1. Adhesions / Adherence
    - 2. Ankylosis
      - a. Fibrous
      - b. Osseous
  - C. Hypermobility disorders/ dislocation
    - 1. Subluxation
    - 2. Luxation
- **3. Joint diseases**
  - A. Degenerative joint disease
    - 1. Osteoarthritis
    - 2. Osteoarthrosis
  - B. Condylar resorption/condylysis
  - C. TMD attributed to systemic arthritides
    - 1. Rheumatoid arthritis
    - 2. Juvenile idiopathic arthritis
    - 3. Metabolic arthritis
    - 4. Other
  - D. Neoplasm
  - E. Chondromatosis
- **4. Fractures**
- **5. Congenital/developmental disorders**
  - A. Aplasia
  - B. Hypoplasia
  - C. Hyperplasia

II. MASTICATORY MUSCLE DISORDERS

1. Muscle pain
- A. Myalgia
  - 1. Local myalgia
  - 2. Myofascial pain
  - 3. Myofascial pain with referral
- B. Tendonitis
- C. Spasm
- D. Myositis

2. Contracture

3. Hypertrophy

4. Neoplasm

5. Movement Disorders
- A. Dyskinesia
- B. Dystonia

6. Masticatory muscle pain attributed to systemic/central pain disorders
- A. Fibromyalgia/ widespread pain
- B. Centrally mediated regional myalgia

III. Headache

1. Headache attributed to TMD

IV. Associated structures

1. Coronoid hyperplasia

Table 4. From RDC/TMD to DC/TMD: Changes in diagnostic algorithms for pain-related TMD		
	RDC/TMD	**DC/TMD**
HISTORY (applicable to all pain-related TMD disorders)		
Presence of masticatory system pain in past 30 days	✓	✓
Pain modification with jaw movement, function, or parafunction		✓
EXAMINATION		
Arthralgia		
Confirmation of location of pain in the joint		✓
Pain with joint palpation		
• Lateral pole	✓	✓
• Around lateral pole		✓
• Posterior site	✓	
Familiar pain with palpation		✓
Familiar pain with range of motion		✓
Myalgia ("Myofascial pain" in RDC/TMD)		
Confirmation of location of pain in a masticatory muscle		✓
Pain with muscle palpation		
• Temporalis	✓	✓
• Masseter	✓	✓
• Posterior mandibular region	✓	
• Submandibular region	✓	
• Lateral pterygoid area	✓	
• Temporalis tendon	✓	
Pain with maximum unassisted or assisted opening		✓
Familiar pain with palpation or opening		✓
Myofascial pain with referral (new diagnosis)		
Sustained palpation with identification of referral patterns		✓

Table 5. From RDC/TMD to DC/TMD: Changes in diagnostic algorithms for disc displacements and degenerative joint disease with new history - based diagnosis of subluxation.

	RDC/TMD	DC/TMD
HISTORY		
"In last 30 days, any noise present" pertains to disc displacement with reduction with and without intermittent locking, and degenerative joint disease.		✓
"In last month, jaw locks with limited mouth opening and then unlocks" pertains to disc displacement with reduction with intermittent locking		✓
"Jaw lock or catch so that it would not open all the way" pertains to disc displacement without reduction with and without limited opening		✓
"When you opened your mouth wide, jaw lock or catch so that it would not close all the way" pertains to subluxation.		✓
EXAMINATION		
Disc Displacement with Reduction		
Click detection	2 of 3	1 of 3
5mm between reciprocal clicks	✓	
Elimination of click in protrusive position	✓	
Disc Displacement with Reduction, with Intermittent Locking		✓
Disc Displacement without Reduction, with Limited Opening		
Unassisted opening of ≤ 35mm and assisted opening ≤ 4mm more than unassisted opening	✓	
Assisted opening < 40mm		✓
Contralateral movements < 7mm and/or uncorrected deviation to the ipsilateral side on opening	✓	
Absence of noise, or noise not meeting criteria for disc displacement with reduction	✓	
Disc Displacement without Reduction, without Limited Opening		
Unassisted opening > 35mm and assisted opening > 4mm more than unassisted opening	✓	
Assisted opening ≥ 40mm		✓
Contralateral and protrusive movements ≥ 7mm	✓	
Noise not meeting criteria for disc displacement with reduction	✓	
Degenerative Joint Disease		
Coarse crepitus with palpation	✓	
Crepitus (fine or coarse) with palpation		✓
Crepitus reported by patient with range of motion		✓

Table 6. Recommended Axis II Assessment Protocol				
Domain	Instrument	# items	Screening	Comprehensive
Pain intensity	Graded Chronic Pain	3	✓	✓
Pain locations	Pain drawing	1	✓	✓
Physical function	Graded Chronic Pain	4	✓	✓
Limitation	JFLS-short form	8	✓	
	JFLS-long form	20		✓
Distress	PHQ-4	5	✓	
	PHQ-9*	10		✓
Anxiety	GAD-7	7		✓
Physical symptoms	PHQ-15*	15		✓
Parafunction	Oral Behaviors Checklist	21	✓	✓

* The RDC/TMD depression and non-specific physical symptoms instruments could be substituted for the PHQ-9 and PHQ-15, respectively, if continuity with legacy data is important.

Table 7. Clinical and Research Applications of Selected DC/TMD Axis I and Axis II Tests				
	Axis I: Physical Diagnosis		Axis II: Psychosocial Status	
	Pain Diagnoses	Joint Diagnoses	Distress and Pain Disability	
Application	Clinical or Research		Clinical	Clinical or Research
Screening Test	TMD Pain Screener	DC/TMD for DD, DJD and Dislocation	PHQ-4 GCPS	PHQ-9 GAD-7 PHQ-15 GCPS
Confirmatory Test	DC/TMD for Arthralgia, Myofascial Pain and Headache attributed to TMD	Imaging: MRI for DD and CT for DJD	Consultation with Mental Health Provider	Structured Psychiatric or Behavioral Medicine Interview